REMARKS

Claims 1, 17, 34-52, 56, 60, 64, 68, 78-84 and 90-92 are now presented for examination. Claims 1, 17, 34, 35, 48, 56, 60, 64, 68, 78, 84 and 90-92 have been amended to define still more clearly what Applicants regard as their invention, in terms which distinguish over the art of record. . Claims 1, 17, 34, 35, 48, 52, 56, 60, 64, 68, 78, 84 and 90-92 are the only independent claims.

Claims 1, 17, 34-37, 39-42, 48-52, 56, 60, 64, 68, and 90-92 are rejected under 35 U.S.C. § 102(b) as anticipated by Curry (U.S. Patent No. 5,696,604). Claims 38, 46 and 47 have been rejected under 35 U.S.C. § 103(a) as obvious over Curry in view of Parker et al. (U.S. Patent No. 5,341,228). Claim 43 has been rejected under 35 U.S.C. § 103(a) as obvious over Curry in view of Hayashi et al. (U.S. Patent No. 5,801,845). Claims 44 and 45 have been rejected under 35 U.S.C. § 103(a) as obvious over Curry in view of Kelly et al. (U.S. Patent No. 5,528,387).

Independent Claims 1, 17, 34 and 35 as currently amended are directed to an image recording arrangement that performs recording using a dot pattern corresponding to each gradation value based on image data representing each pixel with gradation value. According to the method, one dot pattern is selected based on gradation value information of the pixel of the image data and position information of the pixel from a dot-pattern table having plural different dot patterns associated with gradation value and pixel position. An ink dot is recorded based on the selected dot pattern on the recording medium using a recording head. The dot pattern table has plural different dot patterns, each having the same dot number and a different dot arrangement corresponding to the same gradation value. The plural different dot patterns corresponding to the same gradation value are associated with plural pixel positions

corresponding to plural pixels arranged in a first direction substantially corresponding to the direction of arrangement of nozzles of the recording head.

In Applicant's view, Curry discloses a printing device (10) that can be commanded to print a reference set of intensity values from almost white or highlight regions through almost dark or shadow regions. A measuring device measures the actual outputted printer intensity levels from the printing device. An interpolator interpolates the printer intensity levels into a best fit smooth curve plotted against the reference set of intensity levels which produces a non-linear function. A mapping unit and converter (24a, 24b) calculates a set of fractional intensity values and densities which produce a linear function when mapped with the printer intensity levels. A dot area parameter calculator calculates a set of dot parameters defining a configuration of a halftone dot required to fill an area within the halftone cell corresponding to each intensity level. For each position of each halftone cell, a measurement processor determines a distance between a current scan position (a,b) and a nearest edge defined by the dot parameters. A gray value calculator calculates a gray value for the current scan position based on the distance and angle to the nearest edge of the dot. The halftone dot is completed when a gray value is calculated for each position within the halftone cell. The gray values are stored in a look-up table. When a new image is to be printed, the intensity values are input and the scan position is indexed through all available scan positions to generate corresponding addresses in the look-up table, causing the corresponding gray values to be output serially in order for use by a laser diode controller of a laser printer or analogous controllers in other types of printers.

According to the invention of Claims 1, 17, 33 and 35, (a) one dot pattern is selected based on gradation value information of the pixel of the image data and position information of the pixel from a dot-pattern table having plural different dot patterns associated with gradation

value and pixel position. The dot pattern table having plural different dot patterns associated with gradation value and pixel position has a plurality of different dot patterns, each having the same dot number and a different dot arrangement corresponding to the same gradation value and (b) the different dot patterns corresponding to the same gradation value are associated with plural pixel positions corresponding to a plural of pixels arranged in a nozzle arrangement direction. Advantageously, according to (a), the frequency of nozzle usage can be equalized and, according to (b), the effect of nozzle characteristics can be reduced by arranging the dot patterns based on the nozzle characteristics.

It is a feature of Claims 1, 17, 33 and 35 that a dot pattern table has a plurality of different dot patterns, each having the same dot number and a different dot arrangement corresponding to the same gradation value. Curry may provide a number of halftone cells which correspond to a range of intensity levels (Fig. 4A) with one halftone cell arranged according to particular intensity level (Fig. 4B). As the intensity level increases in the Curry arrangement, the dot area formed in the halftone cell increases (Fig. 5). The set of halftone cells in Curry are stored in a memory. When printing is conducted, the halftone cell is read from the memory and used. As a result, the Curry arrangement only has one halftone cell that corresponds to a particular intensity level. Accordingly, it is not seen that Curry's halftone cell arrangement which only provides one halftone cell to corresponds to an intensity level could possibly teach or suggest the structure of Claims 1, 17, 33 and 35 wherein a plurality of halftone cells having the same dot number and different dot arrangements correspond to the same intensity level.

It is a further feature of Claims 1, 17, 33 and 35 that the different dot patterns corresponding to the same gradation value are associated with plural pixel positions corresponding to a plural of pixels arranged in a nozzle arrangement direction. As previously

noted, Curry is restricted to an arrangement in which only one halftone cell is provided for the same intensity level. Accordingly, Curry's one halftone cell for the same intensity level is directed away from and fails in any manner to teach or suggest the different dot patterns for one gradation level in the direction of the nozzle arrangement. In at least the foregoing respects, pending Claims 1, 17, 33 and 35 are completely distinguished from Curry and are allowable.

Independent Claims 48, 56, 60 and 64 as currently amended are directed to an image recording arrangement that performs recording using a dot pattern corresponding to each gradation value based on image data representing each pixel by one of N gradation values. In the arrangement, image data is input that includes gradation value information and position information relating to each pixel. One dot pattern is selected based on gradation information and position information of the pixel of the input image data from a dot pattern table storage unit that stores X ($N > X$, X is a natural number) dot patterns, each having plural different dot patterns corresponding to the respective ones of X gradation values. Dot patterns are generated corresponding to the (N - X) predetermined gradation values by a dot pattern generating unit. When a dot pattern table corresponding to the gradation value information is stored in the dot pattern table storage unit, the selected dot pattern is recorded by a recording head and when a dot pattern table corresponding to the gradation value information is not stored in the dot pattern table storage unit, dot patterns corresponding to the predetermined gradation values by a dot pattern generation unit are recorded by the recording head. In Claims 52, 56, 64 and 68, the dot pattern table is two dimensional, expands in a first direction of nozzle arrangement and in a second direction, the number of cells L in the nozzle arrangement direction and the number of nozzles A being related by $L = \propto x A$.

It is one feature of Claims 48, 52, 56, 60, 64 and 68 that a dot pattern table having plural different dot patterns associated with gradation value and pixel position has a plurality of different dot patterns, each having the same dot number and a different dot arrangement corresponding to the same gradation value. As discussed with respect to Claims 1, 17, 33 and 35, the Curry arrangement provides a number of halftone cells corresponding to a range of intensity levels but with only one halftone cell for each intensity level and with the dot area of the halftone cell increasing with increasing intensity level. As a result, it is not seen that Curry's halftone cell arrangement which only provides one halftone cell to corresponds to an intensity level could possibly teach or suggest the structure of Claims 48, 52,56, 60, 64 and 68 wherein a plurality of halftone cells having the same dot number and different dot arrangements correspond to the same intensity level.

It is a further feature of Claims 48, 52, 56, 60, 64 and 68 that the dot pattern tables are set only for X (N>X) gradation-values among N gradation-values and not set for N-X gradation-values. For X (N>X) gradation-values, the dot pattern assigned to target pixel is selected from the dot pattern table but for N-X gradation-values, the dot pattern assigned to target pixel is generated by a dot pattern generating unit. Advantageously, the capacity of the dot pattern table memory is reduced. As shown in Fig. 4 of Curry, halftone cells are provided for all intensity levels that are to be recorded. Accordingly, there is no dot pattern generating unit that generates a dot pattern when there is no dot pattern table corresponding to the gradation value information stored in the dot pattern table storage unit. It is therefore not seen that Curry in any manner suggests the features of Claims 48, 52, 56, 60, 64 and 68. It is an additional feature of Claims 52, 56, 64 and 68 that a two dimensional dot pattern table is used with the number of cells in the nozzle arrangement direction L being related to the number of nozzles A by $L = \propto x A$. Curry

fails in any manner to teach or suggest any relationship between halftone cells and the number of nozzles of a printing device. In at least the foregoing respects, pending Claims 48, 52, 56, 60, 64 and 68 are completely distinguished from Curry and are allowable.

Independent Claims 90, 91 and 92 as currently amended are directed to an image recording method that performs image recording using a dot pattern corresponding to each gradation value based on image data representing each pixel with a gradation value. According to the method, one dot pattern is selected based on gradation value information of the pixel on the image data and position information of the pixel from a dot pattern table having plural different dot pattern associated with gradation value and pixel position. An ink dot is recorded on a recording medium based on the selected dot pattern using a recording head. The dot pattern table has plural different dot patterns each having the same dot number and a different dot arrangement corresponding t the same gradation value. In Claim 90, the dot pattern table is repeatedly used at each of plural pixels in a first direction substantially corresponding to a direction of arrangements of nozzles of the recording head. In Claim 91, the dot pattern table is repeatedly used at each of plural pixels in a second direction substantially orthogonal to the direction of arrangement of the nozzles of the recording head. In Claim 92, the dot pattern table is repeatedly used at each of plural pixels in a first direction substantially corresponding to the direction of arrangement of nozzles of the recording head and is repeatedly used at each of plural pixels in a second direction orthogonal to the first direction.

It is a feature of Claims 90, 91 and 92 that a dot pattern table has plural different dot pattern each having the same dot number and a different dot arrangement corresponding to the same gradation value. As discussed with respect to Claims 1, 17, 33 and 35, Curry only provides one halftone cell that corresponds to a particular intensity level. It is therefore not seen that

Curry's halftone cell arrangement which only provides one halftone cell for an intensity level could possibly teach or suggest the structure of Claims 90, 91 and 92 in which a plurality of halftone cells having the same dot number and different dot arrangements correspond to the same intensity level.

It is a further feature of Claim 90 that the dot pattern is repeatedly used at each of plural pixels in the direction of nozzle arrangement of a recording head, of Claim 91 that the dot pattern is repeatedly used at each of plural pixels in a direction orthogonal to the nozzle arrangement direction and of Claim 92 that the dot pattern table is repeatedly used at each of plural pixels in the nozzle arrangement direction and is repeatedly used at each of plural pixels in a direction orthogonal to the first direction. Since Curry has only one halftone cell for each intensity level, it is not seen that Curry could possibly suggest the use of a number of different dot patterns of a dot pattern table repeatedly in relation to a nozzle arrangement direction. In at least foregoing respects, it is believed that Claims 90, 91 and 92 are completely distinguished from Curry and are allowable.

Claims 78-80, 82, and 84 are rejected under 35 U.S.C. § 103(a) as obvious over Curry in view of Broddin et al. (U.S. Patent No. 5,799,137). Claims 81 and 83 are rejected under 35 U.S.C. § 103(a) as obvious over Curry in view of Broddin et al. and further in view of Slade (U.S. Patent No. 5,982,993).

Independent Claims 78 and 84 are directed to an image recording arrangement that performs recording using a dot pattern corresponding to each gradation value by applying recording materials having plural colors by a recording unit. In the arrangement, a dot pattern table having plural different dot patterns associated with gradation value and pixel position are stored in a dot pattern table storage unit for each color of the recording materials. One dot

pattern is selected from the dot pattern table storage unit based on gradation value information and color information of the image data pixel and the pixel position information. The size of the dot pattern table corresponding to at least one specific color among the dot pattern table stored in the dot pattern table storage unit for each of the plural colors is smaller than sizes of dot pattern tables corresponding to colors other than the specific color.

In Applicants' opinion, Broddin, et al. discloses an arrangement for color reproduction in which at least three halftone images are printed on top of each other. Each image is rendered on a recorder grid of microdots and has isolated halftone dots. The area outside the halftone dots has a minimum background density Dmin. The halftone dots have at least one microdot with a density level D1 and at least one microdot with a different density level D2. D1 and D2 are both higher than Dmin. The centers of the halftone dots are arranged along a first set of parallel equidistant base lines having a first orientation and along a set of parallel equidistant auxiliary lines having a different orientation. The points of intersection of any base line with any auxiliary line have an identical relative position with respect to the microdot closest to the point of intersection.

It is a feature of Claims 78 and 84 that a dot pattern table having plural different dot patterns associated with gradation value and pixel position has a plurality of different dot patterns, each having the same dot number and a different dot arrangement corresponding to the same gradation value. As discussed with respect to Claims 1, 17, 33 and 35, the Curry arrangement provides a number of halftone cells corresponding to a range of intensity levels but with only one halftone cell for each intensity level and with the dot area of the halftone cell increasing with increasing intensity level. Accordingly, it is not seen that Curry's halftone cell arrangement which only provides one halftone cell to corresponds to an intensity level in any

manner teaches or suggests the structure of Claims 78 and 84 wherein a plurality of halftone cells having the same dot number and different dot arrangements correspond to the same intensity level.

It is an additional feature of Claims 78 and 84 that the size of the dot pattern table corresponding to a specific color among the stored dot pattern tables for plural colors is smaller than the sizes of dot pattern tables for other colors. Advantageously, the capacity of the table memory is reduced for specific colors having less uneveness. As noted by the Examiner, Curry does not disclose the use of plural colors, outputting dot patterns based on color information, or changing the size of a dot pattern table corresponding to a specific color to be smaller than sizes of dot pattern tables of other colors. Broddin, et al. may disclose at lines 30-45 of column 9 that a color yellow is less critical because it looks less dense to a human observer and it has less side absorptions in the visual band so that for the yellow component the halftone cell structure for the black component can be taken and be mirrored along a horizontal axis or a vertical axis or one fixed point or any sloping line at 45 degrees. There is, however, no suggestion of the use of a smaller size table of dot patterns resulting from the less dense look of yellow which in Broddin, et al. only affects a black component.

Since neither Curry nor Broddin, et al. in any manner teach or suggest the feature of a dot pattern table having plural different dot patterns and neither reference suggests anything about the size of different color halftone cell tables, it is not seen that the addition of Broddin, et al.'s simple recognition of yellow looking less dense to an observer and having less side absorptions in the visual band to Curry's one halftone cell for a halftone cell table could possibly suggest anything about the size of the dot pattern table corresponding to a specific color among the stored dot pattern tables for plural colors being smaller than the sizes of dot pattern tables for

other colors. Accordingly, it is believed that Claims 78 and 84 are completely distinguished from any combination of Curry and Broddin, et al. and are allowable.

A review of the other art of record has failed to reveal anything which, in Applicants' opinion, would remedy the deficiencies of the art discussed above, as references against the independent claims herein. Those claims are therefore believed patentable over the art of record.

The other claims in this application are each dependent from one or another of the independent claims discussed above and are therefore believed patentable for the same reasons. Since each dependent claim is also deemed to define an additional aspect of the invention, however, the individual reconsideration of the patentability of each on its own merits is respectfully requested.

In view of the foregoing amendments and remarks, Applicants respectfully request favorable reconsideration and early passage to issue of the present application.

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